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THE INTERRELATION OF SIZE OF SEED PIECE AND RATE OF APPLICATION OF FERTILIZER IN THE PRODUCTION OF POTATOES IN ALABAMA

L. M. WARE

Alabama Agricultural Experiment Station, Auburn, Ala.

The experiment on which this discussion is based is a companion experiment to the one which appeared in an earlier issue of this journal under the title of "The Interrelation of Spacing of Seed Pieces and Rate of Application of Fertilizer in the Production of Potatoes in Alabama." The purposes of the large investigation and the general procedure have been outlined in the earlier discussion and should be reviewed in connection with this experiment. In the previous experiment the quantity of seed planted to an acre was regulated by the interval between seed pieces, all seed pieces being one ounce in size. In this experiment the quantity of seed was regulated by the size of seed piece used, all pieces being equally spaced at sixteen inches. Four sizes of seed pieces were used at each of three rates of application of fertilizer. The seed pieces weighed ½ ounce, ¾ ounce, 1 ounce, and 1-½ ounces respectively, and the rates of fertilizer application were 1000, 1500, and 2000 pounds to the acre. At one rate of fertilizer application 2-ounce pieces were used.

The yield, the cost of materials for an acre, the cost of producing each bushel of potatoes, and the value of the crop on an acre above the cost of materials are given in table 1. The value of an acre of potatoes above the cost of materials is given in table 2 for different combinations of prices paid for seed and received for potatoes. In all instances increases in the yield of No. 1 potatoes have been obtained for each increase in size of seed piece or in the amount of fertilizer used. Increases in yield, however, for given increases in seed or fertilizer used have not been uniform throughout the range of combinations. With 1000 pounds of fertilizer to the acre, an increase in the size of seed from ½ to ¾ ounce gave an increase in yield of

TABLE 1.—*Yields, costs, and value of potatoes produced by different sizes of seed and different rates of application of fertilizer at normal prices for seed and market potatoes.***

Size of Seed Piece *	Seed for One Acre	Yield No. 1 Potatoes on One Acre			Cost of Materials for One Acre**			Cost of Producing Each Bushel of Potatoes			Value of Potatoes on One Acre above Cost of Materials**		
		Rate of Fertilizer Application to an Acre											
		1000 Pounds	1500 Pounds	2000 Pounds	1000 Pounds	1500 Pounds	2000 Pounds	1000 Pounds	1500 Pounds	2000 Pounds	1000 Pounds	1500 Pounds	2000 Pounds
Ounces	Bu.	Bu.	Bu.	Bu.	Dollars	Dollars	Dollars	Cents	Cents	Cents	Dollars	Dollars	Dollars
½	5.67	103	126	129	23.50	31.00	38.50	22.91	24.60	29.84	79.50	95.00	90.50
¾	8.50	114	135	158	27.75	35.25	42.75	24.34	26.12	27.05	86.25	99.75	115.25
1	11.33	127	150	168	32.00	39.50	47.00	25.19	26.33	27.97	95.00	110.50	121.00
1½	17.00	133	179	183	40.50	48.00	55.50	30.45	26.81	30.32	92.50	131.00	127.50
2	22.66		183			56.50			30.9			126.50	

*All seed pieces spaced 16 inches apart in 30-inch rows.
**Calculations based on market potatoes at $1.00 for a bushel of No. 1's, on seed potatoes at $1.50 for a bushel and on fertilizer at $30.00 for a ton.
***A 6-10-6 (N-P-K) fertilizer was used.

TABLE 2—*Value of potatoes on one acre above cost of seed and fertilizer for different sizes of seed piece and different rates of fertilizer application when different prices are paid for seed and received for market potatoes.**

Size of Seed**	Seed per Acre	When Seed Cost $1.50 for Each Bushel and Potatoes Bring $1.00 for a Bushel			When Seed Cost $1.50 for Each Bushel and Potatoes Bring $1.50 for a Bushel			When Seed Cost $2.40 for Each Bushel and Potatoes Bring $1.00 for a Bushel			When Seed Cost $2.40 for Each Bushel and Potatoes Bring $1.50 for a Bushel		
		Rate of Fertilizer Application to an Acre											
		1000 Pounds	1500 Pounds	2000 Pounds	1000 Pounds	1500 Pounds	2000 Pounds	1000 Pounds	1500 Pounds	2000 Pounds	1000 Pounds	1500 Pounds	2000 Pounds
Ounces	Bu.	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars
½	5.67	79.50	95.00	90.50	131.00	158.00	155.00	74.40	89.90	85.40	125.90	152.90	149.90
¾	8.50	86.25	99.75	115.25	143.25	167.25	194.25	78.60	92.10	107.60	135.60	159.60	186.60
1	11.33	95.00	110.50	121.00	158.50	185.50	205.00	84.80	100.30	110.80	148.30	175.30	194.80
1½	17.00	92.50	131.00	127.50	159.00	220.50	219.00	77.20	115.70	112.20	143.70	205.20	203.70
2	22.66		126.53			218.00			106.10			197.60	

*Based on yield of No. 1 potatoes; fertilizers calculated as $30.00 for a ton.
**Spacing 16 inches in 36-inch rows.

11 bushels of potatoes for only 2.83 additional bushels of seed, or gave a return of 3.88 bushels of harvested potatoes for 1 bushel of extra seed. Based on a general average of prices received for marketed potatoes and the prices paid for seed potatoes, a return of 1-½ bushels of potatoes for each bushel of seed means an approximately even money exchange. A return, therefore, of at least 2 bushels of potatoes for 1 bushel of seed is the lowest return which could usually be considered profitable; a much larger return should be obtained. A further increase in the size of seed piece from ¾ to 1-ounce pieces with 1000 pounds of fertilizer to the acre gave an increase in yield of 13 bushels of potatoes for 2.83 additional bushels of seed or gave a return of 4.59 bushels of potatoes for 1 bushel of seed. With the same low amount of fertilizer, a still further increase in size of seed from 1- to 1-½-ounce pieces gave only 6 bushels increased yield for 5.67 bushels of extra seed or a return of 1 bushel of potatoes for 1 bushel of seed. With only 1000 pounds of fertilizer the 1-ounce piece is the largest piece economically justified; a 1-½-ounce piece cannot be justified. This may be explained very logically. The size of seed determines more than any other factor the size of the plant produced. In this experiment no amount of fertilizer has overcome the small size of plant produced by a small seed piece. The size of plant may be considered as determining the size of the starch manufacturing unit; the amount of fertilizer used may be considered as determining the degree to which the full capacity of the manufacturing unit may be utilized. A 1-½-ounce seed piece develops a plant with capacity to produce a yield greater than is permitted by only 1000 pounds of fertilizer; hence, with this rate of fertilizer little increase in yield resulted from increasing the size of seed from 1 ounce to 1-½-ounces.

With 1500 pounds of fertilizer supplied to the acre, increases in the size of seed pieces gave increases in yield throughout the series, the 1-½-ounce seed piece gave an increase in yield above the 1-ounce piece approximately as large for each extra bushel of seed planted as any other increase in size of seed, although the increase in yield of the 2-ounce piece above the 1-½-ounce piece was small. With 1500 pounds of fertilizer progressive increases in the size of piece from ½ to ¾ ounce, from ¾ to 1 ounce, from 1 to 1-½-ounces, and from 1-½ to 2 ounces gave increased yields of 9, 15, 27, and 4 bushels to the acre, respectively. The increase in size of seed piece from ½ to ¾ ounce gave a return of 3.18 bushels of potatoes for each additional bushel of seed; similarly for the next two increases in size of seed piece, returns of 5.3 for 1 and 4.75 for 1 were obtained. It

required, however, 1.41 bushels of seed for each bushel increase in yield as the seed pieces were increased from 1-½ to 2 ounces. It is obvious, therefore, that an application of 1500 pounds of fertilizer to the acre was sufficient to permit quite effective utilization of the increased photosynthetic capacity of the top produced by a 1-½-ounce piece over that produced by a 1-ounce piece; the limit was apparently reached, however, with 1-½-ounce pieces.

With 2000 pounds of fertilizer supplied to the acre, increases in yields of 29, 10, and 15 bushels of potatoes to the acre were obtained by increasing the size of piece from ½ to ¾ ounce, from ¾ to 1 ounce, and from 1 ounce to 1-½ ounces, respectively. These increases gave corresponding returns in potatoes for the additional seed planted of 10.25 bushels for 1, 3.54 bushels for 1, and 2.64 bushels for 1. The yields with 2000 pounds bring out three points of special interest: first, the very low yield obtained from the ½-ounce pieces with 2000 pounds of fertilizer should be noted; second, the very high returns obtained by increasing the size of seed from ½— to ¾-ounce pieces; third, the small increase obtained in yield by increasing the fertilizer application from 1500 to 2000 pounds to the acre with 1-½-ounce seed piece. The general trend of the results indicates that the low yield obtained with ½-ounce pieces and the 2000 pounds of fertilizer to the acre resulted from the use of a seed piece so small that the top produced was of insufficient capacity to permit full utilization of the fertilizer supplied. An application of 2000 pounds to the acre produced only 3 additional bushels of potatoes when compared with the use of 1500 pounds. An application, therefore, of 1500 pounds was sufficient to supply all fertilizer needed by so small a plant as that produced by a ½-ounce piece. The increase in yield of 29 bushels from the use of 2.83 additional bushels of seed, as the seed pieces were increased from ½ to ¾ ounce was the logical result of the correction of a poorly balanced combination. The application of 2000 pounds of fertilizer was too much for a ½-ounce piece, and a very large increase in yield was the very logical result of a small increase in the size of seed piece. The small increase in yield from potatoes receiving 2000 pounds of fertilizer and planted with 1-½-ounce pieces compared with the yield of potatoes receiving 1500 pounds and planted with 1-½-ounce pieces indicates that the maximum capacity of the land under the seasonal conditions which have obtained during the experiment has been rather closely approached.

A study of the data on the cost of producing each bushel of potatoes reveals some interesting facts. It may be seen that little relation exists between the cost of production of a bushel of potatoes

and the most profitable returns from an acre. The least intensive combination produced potatoes at the lowest cost for each bushel, although this combination gave the lowest returns over the cost of materials from an acre. However, it appears that the cost of materials for each bushel offers a very good index of the correct balance between the amount of fertilizer and the amount of seed used: a low production cost for each bushel indicates a correctly balanced combination; a high production cost for each bushel indicates either an unbalanced combination or the use of a combination too intensive under the seasonal conditions obtaining to permit efficient use of the material supplied. There are only four combinations which appear to be definitely out of balance. With 1000 pounds of fertilizer to each acre and 1-½-ounce pieces, the cost of material for each bushel of potatoes produced was 30.45 cents; this high cost is apparently caused by an insufficient amount of fertilizer to permit effective use of the large plant produced by the 1-½-ounce piece. With the use of 2000 pounds of fertilizer and ½-ounce seed pieces, the cost of material for each bushel was 29.84 cents; this high cost is possibly caused by too small a seed piece to produce a plant large enough to fully utilize the fertilizer supplied. With 2000 pounds of fertilizer to each acre and 1-½-ounce pieces and with 1500 pounds of fertilizer to the acre and 2-ounce pieces the cost of materials for each bushel was above 30 cents; these prices were apparently caused by the limiting factor introduced by an approach to the maximum productive capacity of the soil under the moisture limitations which have obtained during the experiment and the inability of the land to support yields large enough to permit most effective use of the large amounts of fertilizer and seed used in these combinations.

The value of the crop on each acre after the cost of materials has been deducted in the final analysis largely, although not always, determines the most desirable combination. In this experiment the largest returns from an acre above the cost of materials at all combinations of prices paid for seed and received for market potatoes have been obtained by the use of 1500 pounds of fertilizer to the acre and 1-½-ounce pieces. Returns from 2000 pounds of fertilizer and 1-½-ounce pieces, from 1500 pounds of fertilizer and 2-ounce pieces, and from 2000 pounds of fertilizer and 1-ounce pieces follow very closely.

It is not correct under all conditions to assume that the most desirable combination is always the one giving the largest return from an acre above the cost of materials. Where there is a surplus of land, where a farmer's family is large and outside employment not available, where other cash crops are not available, and where capital funds are—

absent and credit is limited, it may be of distinct benefit for a grower with a limited total acreage in potatoes to spread his investment in seed and fertilizers over a larger number of acres and capitalize on his family labor. This assures him of a market for the family labor. A few examples will suffice to illustrate the point. The combination of 1000 pounds of fertilizer to the acre and ½-ounce seed pieces cost $23.50 to the acre for materials at normal prices. The combination of 2000 pounds and 1-½-ounce pieces cost $55.50 for each acre. With the same investment in seed and fertilizer, 2.36 acres of the first combination may be planted for what it costs to plant 1 acre of the second combination. The yield on 2.36 acres from the first combination would be 243 bushels. The yield from the second combination on the one acre with the same investment in seed and fertilizer was 183 bushels. The difference in yield is 60 bushels. With the first combination it would be necessary to plant, cultivate, and harvest potatoes on 1.36 additional acres. At $1.00 for each bushel of potatoes the value of potatoes on the additional 1.36 acres would be $60.00. This affords a market for the family labor at $44.12 for each acre. At $1.50 received for a bushel of potatoes the family labor would receive $66.18 for caring for each of the 1.36 extra acres or a total of $90.00 more for the same investment in seed and fertilizers.

By a similar comparison of these same combinations, but assuming a high price for seed and a normal price for potatoes, the farmer would obtain, for the same investment in seed and fertilizer, $48.50 for his family labor on each of the 1.47 extra acres in potatoes or a total of $71.41 for the same investment. With high prices paid for seed and high prices received for potatoes the farmer's labor would earn $72.10 on each 1.47 extra acres or a total of $106.00 more for the same expenditure for seed and fertilizers. These figures are based on a comparison of a combination of 1000 pounds per acre of fertilizer and ½-ounce pieces and a combination of 2000 pounds per acre of fertilizer and 1-½-ounce pieces.

There are circumstances under which a farmer would certainly choose the less expensive combination and plant larger acreages. A comparison of the least expensive combination and the most desirable of all the combinations tested assuming n rmal prices for seed and potatoes, will show a return of $31.00 more for an equivalent investment in materials for the first combination than for the second, the extra land which would have to be handled being 1 acre. This would mean employment for the family at $31.00 an acre. There are circumstances under which a farmer would choose to credit his family's

labor with this amount rather than pay it out for more seed and fertilizers.

Under a different set of circumstances it seems most certain that the combination giving the largest returns to the acre above the cost of materials would be the correct combination. Where land is limited with respect to intended production, if land rental is high, where other money crops are possible, where capital is adequate, and where all labor must be hired, it seems most certain that the combination offering the greatest net return to the acre should be chosen.

A PRELIMINARY REPORT ON THE EFFECTS OF COMMERCIAL FERTILIZERS ON POTATOES IN COLORADO

C. H. METZGER

Colorado State College, Fort Collins, Colorado

Numerous tests of commercial fertilizers for potatoes have been made in Colorado but have shown no profitable increase in yield to date. It has recently been demonstrated, however, that phosphate will not only increase the yield of sugar beets but will also increase the sugar content in some parts of the state. Harrington (1) has pointed out that yield is not the only factor influenced by commercial fertilizers, but that phosphate and ammoniated phosphate also altered tuber shape, skin texture, grade, maturity, and handling qualities. Martin, Brown, and Sprague (2) in a study of the effect of fertilizers on shape found that potash had the greatest influence on shape. Folsom, Owen, and Smith (3) also found that shape was altered by potash.

The Russet Burbank is the leading variety in the Eagle Valley-Carbondale District; and although this district has the highest average yield in the state, a wide variation in tuber shape was noticed, and the tubers in general were not so well shaped as those from Idaho. Some growers, in fact, have been forced to change varieties because of the low percentage of No. 1's and the constant criticism of pointed ends. Since there is a well established market for this variety in the state, it was decided to reinvestigate commercial fertilizers, not only for yield, but also from the standpoint of grade, tuber shape, growth rate, skin texture, and maturity.

Methods

Five fertilizer formulas were used with application rates as follows:

0-43-0	200 pounds per acre	—treble superphosphate
10-53-0	160 pounds per acre	—ammoniated phosphate
4-12-4	700 pounds per acre	—complete
20-0-0	430 pounds per acre	—ammonium sulphate
0- 0-50	172 pounds per acre	—muriate of potash

These rates of application were chosen in order to apply 86 pounds of available phosphate to the acre in the N, NP and NPK plots; 86 pounds of nitrogen in the N plot, and 86 pounds of potash in the K plot.

Three row plots were used, and the center one used to obtain the data. Each fertilizer plot was located between a pair of no treatment plots. There were six replications of each treatment.

Four locations in the state were chosen for these plots. Those in Weld, Garfield, and Rio Grande counties were in cooperation with farmers, whereas the fourth was located at the Mountain Substation in Eagle County. At the Mountain Substation and in Weld County 60-foot, single row plots were used, whereas in Rio Grande and Garfield counties, 50-foot plots were necessary because of the limitations of the fields used. All four fields were planted after alfalfa sod. The Mountain Substation soil was a black, mountain, clay loam; the Garfield County soil was a bright, red, clay loam; the Rio Grande County soil was a gravelly loam; and the Weld County soil was a heavy loam. The plots were furrow-irrigated at all locations.

These locations were chosen, because the market quality of the Russet Burbanks grown on the Mountain Substation and on the Garfield County farm had not been satisfactory. The Weld County location was chosen because sugar beets had responded to phosphate, and the Rio Grande County location resulted from a popular demand for information on yield responses.

All fertilizers were distributed with planter attachments. Those at the Mountain Substation and in Garfield County were placed in bands on each side and a little below the seed piece, while those in Weld and Rio Grande counties had to be distributed ahead of the machine and more or less mixed with the soil by the covering discs because of the limitations of the machine.

Effect on Yield

Three varieties were used, but in each case the variety was the main one for the district in which the test was located. The Russet

Burbank was used at the Mountain Substation and in Garfield County. Perfect Peachblow was used in Rio Grande County, and Rural New Yorker No. 2 was used in Weld County. Students' method for paired plats was used in analyzing the data, calculating the value of "t," and determining significance from Fisher's (4) "t" table. In cases where there was a difference in significance between the treatment and the no-treatment plot on either side of it, the mean of the two no-treatment plots was used to determine significance.

A summary of results is given in tables 1, 2, 3, and 4.

TABLE 1.—*Yields obtained at the Mountain Substation from commercial fertilizers on Russet Burbank potatoes.*

Fertilizer	Yield Cwt. per Acre	Check Cwt. per Acre	Change	"t"	"P"	Significance
N	302.0	319.5	decrease	2.237	.1 to .05	No
NP	336.0	315.5	increase	3.043	.05 to .02	Yes
P	325.0	317.5	increase	.853	.4 to .5	No
NPK	307.0	315.0	decrease	.559	.6 to .7	No
K	303.0	301.0	increase	.890	.4 to .5	No

Ammoniated phosphate was the only fertilizer used which gave a significant change in yield. The increase was 20.5 cwt. to the acre, or 6.5 per cent. Muriate of potash gave inconsistent results showing an insignificant increase over one check and an insignificant decrease when compared with the check on the other side, with an insignificant increase over the mean of the two checks.

The results in Garfield County are given in table 2.

TABLE 2.—*Yields obtained in Garfield County from commercial fertilizers on Russet Burbank potatoes.*

Fertilizer	Yield Cwt. per Acre	Check Cwt. per Acre	Change	"t"	"P"	Significance
N	166.0	203.0	decrease	4.032	.01	Yes
NP	209.0	229.0	decrease	1.020	.3 to .4	No
P	256.0	248.0	increase	.475	.5 to .6	No
NPK	252.0	255.5	decrease	.347	.6 to .7	No
K	253.0	260.0	decrease	.484	.5 to .6	No

Ammonium sulphate gave a very significant decrease on this red soil of 37 cwt. to each acre, or 18.23 per cent.

Treble superphosphate is the only fertilizer showing an increase, but this increase is not significant.

In this test 4-12-4 gave inconsistent results showing a slight gain over one check and a slight decrease below the other, with a slight decrease below the mean of the two.

An examination of the yields of the check plots shows that there was a considerable increase in fertility from the N side to the K side, 75 feet away. This field was on a slope with the K plot on the lower side.

TABLE 3.—*Yields obtained in Rio Grande County from commercial fertilizers on Perfect Peachblow potatoes*

Fertilizer	Yield Cwt. per Acre	Check Cwt. per Acre	Change	"t"	"P"	Significance
N	211.0	211.3	none	0.548	.6	No
NP	236.0	205.0	increase	5.530	.01	Yes
P	232.0	217.5	increase	1.139	.2 to .3	No
NPK	247.0	205.0	increase	2.036	.1 to .05	No
K	221.0	224.0	decrease	....	.....	No

Ammoniated phosphate gave a very significant increase of 31 cwt. to the acre, or 15.12 per cent. The increase from complete fertilizer was greater than that from ammoniated phosphate, but was not significant.

TABLE 4.—*Yields obtained from commercial fertilizers in Weld County on Rural New Yorker No. 2 potatoes*

Fertilizer	Yield Cwt. per Acre	Check Cwt. per Acre	Change	"t"	"P"	Significance
N	120	142	decrease	3.240	.05 to .02	Yes
NP	175	148	increase	3.160	.05 to .02	Yes
P	167	170	decrease	.807	.4 to .5	No
NPK	185	179.5	increase	2.490	.1 to .05	No
K	164	158.5	increase	1.536	.1 to .2	No

Ammonium sulphate significantly decreased the yield 22 cwt. to each acre or, 15.49 per cent. Ammoniated phosphate increased the yield significantly by 27 cwt. or 18.24 per cent. Phosphate gave a significant increase over one check but was significantly inferior to the other check and very little below the mean of the two checks. The complete fertilizer and potash were also inconsistent, outyielding only one check and being outyielded by the other.

Ammoniated phosphate gave significant increases in three of the four tests. Ammonium sulphate decreased the yield in three tests, but significantly only in two. In the fourth test there was no effect. Phosphate increased the yield in three tests, but not significantly. Complete fertilizer increased yields in two tests and decreased them in two tests, and nuriate of potash did the same. The results with phosphate and ammoniated phosphate are similar to those obtained by Harrington (1) in Montana, and Clapp (5) in Kansas.

Effect on Grade

In Colorado the effect of these fertilizers on the grade is probably more important than their effect on yields. These results are given in table 5.

Table 5.—*Effect of commercial fertilizers on the grade of potatoes produced.*

Mountain Substation:

	Per Cent No. 1	Yield No. 1 Cwt. per A	Total Yield
N	75.87	229.13	302.0
NP	82.04	275.65	336.0
P	88.11	286.36	325.0
NPK	82.02	251.80	307.0
K	82.48	249.91	303.0
Mean of Checks	79.76	250.21	313.7

Rio Grande County:

	Per Cent No. 1	Per Cent Below 1⅞"	Yield No. 1	Total Yield
N	68.96	14.83	145.51	211.0
NP	65.07	20.68	153.57	236.0
P	74.89	14.56	173.74	232.0
NPK	75.03	15.29	185.32	247.0
K	79.82	9.80	176.40	221.0
Mean of Checks	76.36	14.22	162.27	212.5

GARFIELD COUNTY:

	Per Cent No. 1	Yield No. 1	Total Yield	Grand Total No. 1—Cwt.
N	74.17	123.12	166.0	497.76
NP	76.34	159.55	209.0	588.77
P	89.77	229.81	256.0	689.91
NPK	83.60	210.67	252.0	647.79
K	73.76	186.61	253.0	612.92
Mean of Checks	80.00	191.28	239.1	603.67

When the yield of U. S. No. 1 is considered, phosphate and 4-12-4 seem to be superior to the check. Muriate of potash and ammonium phosphate are little different from the check, and ammonium sulphate inferior. There was, however, considerable difference in this No. 1 grade. The phosphate was by far the best No. 1 grade with square ends, an excellent finish, and no slick tubers. The 4-12-4 yielded more tubers which were pointed on the stem ends, a number showed small projections at the stem end, and a considerable number of poorly netted tubers were also produced. The potash was a good grade, except for considerable scab on the slick tubers. The poorest No. 1 grade was the ammo-phos with pointed and wedge-shaped stem ends and prominent eyes. The nitrogen plots produced tubers which had pointed stem ends, prominent eyes, lacked netting, and showed some scab.

These results on yield of No. 1 potatoes are in accord with those of Harrington (6), in Montana, in regard to phosphate and nitrogen. The ammo-phos plots produced the second highest yield of No. 1 potatoes at the Mountain Substation, but this was a borderline, No. 1 grade and the poorest in the test. The tubers were of the same type that have been causing serious marketing difficulties in this section and represent a condition which it is the object of this test to overcome. Despite the fact that an increase in total yield was obtained, this material could not be recommended on the basis of this year's test. It is also interesting to note that in Rio Grande and Garfield counties the yield of No. 1 from ammo-phos ranks fifth, only nitrogen being poorer. Since all of the fertilizer experiments were planted on fields, which had previously been in alfalfa, there may have been an adequate supply of nitrogen present in the soil for potatoes.

EFFECT ON STARCH AND DRY MATTER

Samples from two of the tests were analyzed by the Chemistry Section. In the Russet Burbanks from the Mountain Substation the

highest starch was obtained in the ammoniated phosphate plot, being 18.306 per cent. The starch content of the plots was as follows: Phosphate produced a starch content of 17.741; muriate of potash, 17.459; check, 16.950; ammonium sulphate, 15.820; and 4-12-4, 15.360 per cent. The Rural New Yorkers from Weld County ranked as follows: 4-12-4, 17.459 per cent; check, 17.176 per cent; ammoniated phosphate, 16.786 per cent; phosphate, 16.668 per cent; muriate of potash, 16.046 per cent; and ammonium sulphate, 15.481 per cent.

The percentage of dry matter may be as good an indication of quality as starch. In this respect the analyses from the two tests are in much closer agreement than in starch percentage. The highest percentage of dry matter in the Russet Burbanks was from the phosphate plot with 24.800 per cent, followed by ammoniated phosphate, 24.575; 4-12-4, 23.020; check, 22.722; muriate of potash, 22.640; and ammonium sulphate, 22.230 per cent. The Rurals ranked as follows: 4-12-4, 23.93; phosphate, 23.91; muriate of potash, 23.66; check, 23.43; ammoniated phosphate, 22.71; and ammonium sulphate, 22.62 per cent.

Effect of Tuber Shape and Appearance

Some striking results were obtained from the fertilizers used in respect to the appearance of the tubers. The treble superphosphate produced tubers having the best general appearance. The tubers were blunt on the ends, straight, with very little skinning or bruising, no wilting after three months in storage at a low humidity, the netting was excellent, and no scab was present. The tubers from the potash plots ranked second in general appearance. The tubers were short, broad and thick, with blunt ends and in excellent condition three months after storage. The other fertilizers rank as follows: check, nitrogen, complete, and ammo-phos. The nitrogen and complete fertilizer showed the most bruising and subsequent shriveling. The tubers harvested on the plots treated with ammonium phosphate were more or less pointed and wedge-shaped at the stem end, although blunt on the seed end. They were also curved upward and the eyes were more prominent than on any others except those from the nitrogen plots.

In the matter of netting, phosphorus was clearly outstanding, followed by ammo-phos and the check. The complete fertilizer followed the check in rank because it removed part of the netting. Nitrogen removed the netting from the most of the tubers entirely, and many of the slick tubers were scabby. Potash removed even more of the

netting than nitrogen and also showed more scab. Harrington (6) has pointed out the same effects.

Phosphorus also showed the least skinning and bruising of any of the treatments. Potash was nearly as good as phosphorus. The check was third: ammo-phos, fourth; complete fertilizer, fifth, with nitrogen showing the most skinning and bruising.

The differences in the Weld County Rurals were much less pronounced. The tubers from the potash plots were shorter and wider than those from the other plots. The skin texture was also altered, the potash and nitrogen producing slick skins, the phosphate the roughest skin, and the complete fertilizer, check, and ammo-phos intermediate skins. These potatoes were dug when the ground was wet and there was considerable difference in the amount of dirt adhering to the tubers. The ammo-phos produced, by far, the brightest and cleanest tubers. The nitrogen was second; the complete fertilizer third; phosphate, fourth; check, fifth; and potash by far the dirtiest.

For the determination of shape, 100 tubers weighing between 7 and 8½ ounces were selected at random from each treatment, and measured for length, width, and thickness. The measurements and ratios are given in table 6.

TABLE 6.—*Average measurements in centimeters of* 100 *Russet Burbank tubers and shape ratios.*

Treatment	L	W	T	L/W	SE*	W/T	SE*	Shape Index **	Av. Weight Tuber: Oz.
N	12.16	5.98	4.95	2.03	.205	1.21	.107	2.225	7.20
NP	12.66	5.89	4.96	2.16	.252	1.19	.178	2.334	7.52
P	13.10	6.15	5.14	2.13	.241	1.20	.205	2.321	7.84
NPK	12.05	6.07	5.04	1.99	.180	1.20	.091	2.169	7.36
K	12.18	6.42	5.14	1.90	.188	1.25	.107	2.107	8.32
Check	12.95	6.00	5.00	2.16	.280	1.20	.026	2.355	8.00

*SE—Standard Error.
**Proposed by Martin, Brown and Sprague. (2) Shape index $= \frac{2 \times \text{length}}{\text{width} + \text{thickness}}$

The longest tubers were produced by phosphate, whereas the shortest were produced by the complete fertilizer. Potash produced the widest tubers, whereas ammo-phos produced the narrowest. Phosphate and potash produced the thickest tubers and nitrogen produced the thinnest.

The best shape index was produced by potash followed by complete, nitrogen, phosphate, ammo-phos and the check. This is almost in exact agreement with the results obtained by Martin, Brown and Sprague (2) with Irish Cobblers, except that nitrogen and phosphate are reversed, and in their data there is no significant difference between the two.

The lowest length-width ratio was produced by potash, showing that these tubers were wider in proportion to their length than those in the other treatments. Ammos-phos and the check produced the highest length-width ratio, showing that these were longer in proportion to their width, or narrower in proportion to their length than the tubers from the other plots.

The lowest width-thickness ratio was produced by ammo-phos, showing that these tubers were narrower in proportion to their thickness than those from any other plot. Potash produced the highest width-thickness ratio, showing that these tubers were wider in proportion to their thickness than those from any other plot.

Effect on Rate of Tuber Development

Thirty hill samples were dug at weekly intervals from each treatment at the Mountain Substation, beginning July 20 and continuing until October 5. All plots had ben planted on May 18. The tuber weights on the various digging dates are given in table 7.

The differences noted were, first, a tendency for the tuber weights in the potash and nitrogen plots to lag behind those in the other plots until September 14; secondly, that the greatest increase in weight occurred during the first week in September and; thirdly, that the net increase in weight after September 7 was very small in most cases.

Ammoniated phosphate showed the greatest increase after September 7, followed by ammonium sulphate, muriate of potash, phosphate, check, and 4-12-4.

The period of greatest tuber increase seems to be the first week in September. It is imperative, then, in order to secure maximum yields, to supply adequate moisture through irrigation just previous to and during this period.

All treatments made their greatest increase in tuber weight during

TABLE 7.—*Weight of tubers in pounds; weight of vines in pounds and tuber vine ratios for the various sampling dates, 30-hill plots.*

Date	N			NP			P			K			NPK			Check		
	Tubers	Vines	Ratio	Tubers	Vines	Ratio	Tubers	Vines	Ratio	Tubers	Vines	Ratio	Tubers	Vines	Ratio	Tubers	Vines	Ratio
July 20	2.75	25.00	0.109	2.36	22.36	0.106	2.50	22.75	0.110	2.00	21.25	0.094	2.50	26.60	0.094	3.60	26.40	0.136
July 27	4.00	24.00	0.167	7.36	30.00	0.245	7.36	37.36	0.197	5.42	26.42	0.205	7.00	42.00	0.167	8.70	34.60	0.251
Aug. 3	12.00	41.00	0.293	17.75	49.50	0.359	13.10	53.40	0.245	15.00	45.50	0.330	16.00	57.00	0.281	14.60	33.00	0.442
Aug. 10	23.00	43.00	0.535	31.00	73.50	0.422	29.80	54.00	0.552	18.00	57.00	0.316	28.00	62.00	0.452	32.50	59.00	0.551
Aug. 17	37.50	53.00	0.708	38.00	59.50	0.639	38.00	61.00	0.623	37.50	66.00	0.568	41.00	72.00	0.569	42.00	60.50	0.694
Aug. 24	44.50	56.00	0.795	63.50	71.50	0.888	63.50	60.50	1.050	56.50	69.00	0.819	55.00	72.00	0.764	59.50	53.00	1.123
Aug. 31	70.00	52.00	1.346	75.00	58.50	1.293	55.00	61.00	0.902	67.50	45.00	1.500	59.00	59.00	1.000	55.00	40.00	1.375
Sept. 7	82.00	56.00	1.464	72.00	57.00	1.263	93.00	52.00	1.788	85.00	74.00	1.149	99.00	73.00	1.356	100.00	68.00	1.471
Sept. 14	95.00	67.00	1.418	89.00	55.00	1.618	79.00	47.00	1.681	97.00	59.00	1.644	108.00	69.00	1.565	82.00	48.00	1.708
Sept. 21	91.00	56.00	1.625	96.00	49.00	1.959	83.00	48.00	1.729	104.00	43.00	2.419	94.00	63.00	1.492	115.00	43.00	2.674
Sept. 28*	105.00	35.50	2.958	101.00	42.00	2.405	103.00	33.00	3.121	104.00	50.00	2.080	104.00	47.00	2.213	106.00	32.00	3.313
Oct. 5	92.00			97.00			98.00			105.00			92.00			92.00		

* Killing frost Sept. 27.

the first week in September, except nitrogen, which was one week earlier, and ammo-phos, which was two weeks earlier.

The complete fertilizer reached its maximum tuber weight the earliest, which was about September 14.

The check was a week later, and phosphate, nitrogen, and ammo-phos were two weeks later. Potash was latest, reaching its peak October 5, or three weeks later than complete.

A heavy frost killed the vines on September 27 and, contrary to popular belief, all plots except potash showed weight losses on the digging one week later. This also indicates the delaying of maturity tendency of potash.

Effect on Tuber Set

Harrington (6) has stated that phosphate increases the number of tubers to the hill. This is confirmed at the Mountain Substation, where the average of 30 hills showed that 4-12-4 produced 8.20 tubers to each hill; ammonium sulphate, 7.86; ammo-phos, 7.70; phosphate, 7.46; check, 6.80; and potash, 6.56 tubers. Martin, Brown and Sprague (2) found the rank for number of tubers on Irish Cobblers in New Jersey was as follows: 3-9-3, 5.47; nitrogen and phosphate, 5.23; phosphate, 5.16; potash, 5.11; check, 4.88; and nitrogen, 4.14 tubers.

Effect on Vine Development and Appearance

In an examination of all plots in late August, no apparent differences in vine growth or appearance were observed except in Rio Grande County. In this location all checks and the potash and phosphate plots appeared yellow in color, whereas the complete fertilizer, ammo-phos, and nitrogen plots showed deep green color. These differences were reflected in the yields, in that ammo-phos produced a significant increase; 4-12-4 produced a larger increase which was not significant, and ammonium sulphate yielded as much as the check and did not decrease the yield as in other locations.

The vine weights were also obtained for each digging date as described above. These weights are given in table 7. These figures show that the vines made their greatest increase in weight in the week following July 27, which is also the period of bloom. The vines reached their maximum weight by August 24, and declined rapidly after Sept. 7, which may explain the small tuber increase after that date. The decline in vine weight after Sept. 7 may be explained by the fact that the last irrigation was given August 29.

The influence of these fertilizers on maturity and yield is rather strikingly demonstrated by this examination of the vine growth. The ammoniated phosphate produced the heaviest vines in the shortest time, reaching maximum development by August 10. Decline took place after August 24. This may account for the increased yield.

Phosphate produced vines slightly heavier than the check. They reached their maximum development by August 17, and declined after August 31, one week earlier than the check.

The 4-12-4 produced the heaviest vines, being heavier than the check on all sampling dates except the first. Maximum weight was attained by August 17, and decline took place after Sept. 7, which dates are the same as the check.

Potash delayed maturity as maximum weight was not attained until Sept. 7, three weeks after the check, and decline started immediately. These vines started slowly, as they were smaller than the check until August 10.

Nitrogen produces the slowest vine development. The increase in weight is gradual until the maximum is reached Sept. 14, four weeks after the check.

The best stand was secured in the nitrogen plots averaging 89 per cent. The ammos-phos and check both averaged 82; complete, 80; phosphate, 79; and potash, 72 per cent.

The average number of stems for each hill was highest in the check plot, 3.07, followed by nitrogen, 2.98; complete fertilizer 2.84; ammo-phos, 2.71; phosphate, 2.66; and potash, 2.17.

There was very little difference in the height of the vines. Nitrogen, (20½ inches) was 2 inches shorter than the complete fertilizer and phosphate; 1½ inches shorter than ammo-phos, and 1 inch shorter than potash and the check.

Effect on Ratio of Tubers to Vines

The ratios of tubers to vines were calculated for each digging date and are given in table 7. These ratios represent the number of pounds of tubers produced by one pound of vines. The highest ratios are found in the check plot, which means that the check produced the highest yield of tubers for the weight of the vines. The vines in this plot averaged the lightest in the test. Phosphate ranked second in pounds of tubers produced for each pound of vines, although the total weight of vines produced on all digging dates exceeds that of nitrogen. Ammo-phos follows in efficiency, although the total vine weights exceeded all those except the complete fertilizer treatment. Nitrogen

ranked fourth, although it produced the lightest vines of any plot except the check. Potash ranked fifth, and the complete fertilizer, which produced the heaviest vines is least efficient in producing tubers. These rankings have been determined by ranking the ratios for each planting date rather than by taking the mean of the ratios. If the mean of the ratios is taken, potash and the complete fertilizer change places, and ammo-phos becomes fourth instead of third, whereas nitrogen becomes third instead of fourth.

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STORAGE TEMPERATURE STUDIES WITH IRISH COBBLER SEED POTATOES

R. A. JEHLE* AND E. A. WALKER**

University of Maryland, College Park, Md.

Storage temperature studies with Irish Cobbler seed potatoes are being made for the purpose of attempting to overcome certain disadvantages resulting from the use of home grown seed for the production of the early commercial potato crop on the Eastern Shore of Maryland. Northern grown and home grown seed are both used for the production of the early commercial potato crop. The proportion of northern grown and home grown seed which is used depends upon the price of the northern grown seed and the amount of home grown seed which is available for planting. Eastern Shore potato growers prefer to plant home grown seed because they can usually produce it cheaper than they can purchase northern grown seed, and because of its smaller size and

*Specialist in Plant Pathology for the Extension Service and Experiment Station.
**Assistant Specialist in Plant Pathology, Extension Service and Experiment Station.

better shape. The home grown seed is usually produced from certified northern grown seed which has been kept in cold storage during the summer. Sometimes home grown seed is used for the production of the late seed potato crop.

In studies covering a period of five years, the senior writer working with Oswald (6) found that northern grown seed germinated and matured earlier and yielded more than home grown seed when planted for the production of the early Eastern Shore crop of Irish Cobbler potatoes. White (7) found that Virginia Eastern Shore Irish Cobbler seed potatoes came up and matured almost as early as Maine Irish Cobbler seed potatoes when they were placed in a heated basement one month before planting. The senior writer working with Heuberger (5) found that Eastern Shore Irish Cobbler seed potatoes emerged and matured as early and yielded as well, if not better than, northern grown Irish Cobbler seed potatoes when planted at high altitudes in the western portion of Maryland. At these high altitudes the potato crop is planted six to eight weeks later than the crop on the Eastern Shore. White's experiments were also repeated, using Maryland Eastern Shore late crop Irish Cobbler potatoes instead of Virginia seed stock. The seed which was placed in the heated basement on the 15th of January germinated and matured just as early as the northern grown seed, and the seed which was placed in the heated basement on the 15th of February emerged a few days later. Both yielded more than the same seed stock kept in an unheated basement during the entire storage period. The seed placed in a heated basement on the 15th of January yielded more than any of the northern grown seed stocks, whereas the seed placed in a heated basement on the 15th of February was outyielded by only one of them. Results of these experiments were published in the American Potato Journal (5). In 1935 these experiments were repeated by the senior writer. The results of the different treatments on the time of emergence and maturity of the crop were the same, but the yield from the seed stock kept in an unheated basement was larger than the yield of northern grown seed stock and seed stock placed in a heated basement on the 15th of January and on the 15th of February. This was attributed to the dry weather early in the season. The rains came late, and when they did come they were more beneficial to the least mature vines.

In 1936 this work was continued by the writers. Studies were added to compare seed kept at controlled storage temperatures with

seed kept in an ordinary storage cellar, sweet potato storage house, and for a short storage period in a brooder house. In some of the treatments mountain grown seed from Garrett County, Maryland, was included.

Following is a description of the various sources of seed potatoes used in the 1936 tests and the treatments to which they were subjected: The certified Maine seed was purchased from a dealer at Pocomoke, Maryland, on the 5th of November and kept in an unheated basement. The Garrett County, Maryland, seed was grown in the University of Maryland tuber unit test plots at an elevation of approximately 3,000 feet. The crop was dug on the 28th of August and kept in a well ventilated shed until the 14th of November. After that period some of the tubers were kept in an unheated basement and others in controlled temperature chambers. The Maryland Eastern Shore late crop seed was grown from Maine certified seed which had been kept in cold storage during the summer. The crop was harvested on the 4th of November and some of the tubers were kept in an unheated basement, or in a sweet potato storage house during the entire storage period. Others were kept in an unheated basement, heated basement or brooder house part of the time and still other seed was kept in controlled temperature chambers. The temperatures in the unheated basement ranged from 40° F. to 45° F.; in the heated basement 66° to 65° F., in the sweet potato storage house 55° F., and in the brooder house 90° F. The controlled temperature chambers were located at the U. S. D. A. Arlington Farm.*

The samples from each of the seed sources and treatments were removed from storage on the 18th and 20th of March, and planted on the farm of W. T. Pilchard at Pocomoke, Maryland, on the 31st of March and the 1st of April in 1936. Plots from the samples of all the storage treatments, except the constant storage temperature, were approximately one-eighth of an acre in size. After cutting the potatoes, they were planted with a two-man planter containing a fertilizer band-distributing attachment. Four rows were planted from each sample. Four replications were made by dividing the plot crosswise into four equal parts 75 feet long and keeping separate yield records from each of the four parts. The outer two rows of the entire plot were discarded on account of border effect. Only a limited number of tubers could be kept in controlled temperature chambers and the samples from each treatment were small. These samples were planted by hand in another field in four to eight replications. Each

*The writers wish to acknowledge their indebtedness to Dr. D. F. Fisher, who made storage temperature chambers available for this work.

replication consisted of four plants from a single tuber. Two of the replications developed Leaf Roll symptoms, and they were removed before yield records were obtained.

A study of the effect of the various storage temperatures on sprout developments, earliness, yield and physical-chemical properties of the expressed sap was made.

The effect of the various storage temperatures on sprout development of Irish Cobbler seed potatoes was as follows:

1. Maine. Unheated basement entire storage period.
   Apical sprouts ½ to ¾ inches long. Other sprouts very much shorter.
2. Garrett Co., Md. Unheated basement entire storage period.
   Apical sprouts 1 to 1½ inches long. Other sprouts very much shorter.
3. Garrett Co., Md. 40° F. controlled temperature chamber.
   Very slight sprout development. Apical dominance apparent.
4. Maryland Eastern Shore late crop. Unheated basement entire storage period.
   Very slight development of apical sprout. Other eyes show almost no sprout development.
5. Maryland Eastern Shore late crop. 40° F. controlled temperature chamber.
   Buds appear nearly dormant.
6. Garrett Co., Md. 50° F. controlled temperature chamber.
   Apical sprouts 1 to 1½ inches long. Other eyes show short sprouts.
7. Maryland Eastern Shore late crop. 50° F. controlled temperature chamber.
   Apical sprout ⅛ to ¼ inches long. Lateral sprouts much shorter.
8. Maryland Eastern Shore late crop. Kept in a sweet potato storage house (approximately 55° F.) entire storage period.
   Apical sprout ½ to ¾ inches long. Other buds nearly dormant.
9. Garrett Co., Md. 40° F. controlled temperature chamber to the 15th of February; 60° F. controlled temperature chamber to the 20th of March.
   *Apical dominance broken. Numerous sprouts, most of which were ½ to ¾ inches long.

*Definition of apical dominance by Appleman (1) used.

10. Maryland Eastern Shore late crop, 40° F. controlled temperature chamber to the 15th of February; 60° F. controlled temperature chamber to the 20th of March.

    Apical sprout ½ to ¾ inches long. Other eyes have short sprouts.

11. Maryland Eastern Shore late crop. Unheated basement to the 15th of February; heated basement to the 18th of March.

    Apical sprout ½ to ¾ inches long. Other eyes nearly dormant.

12. Garrett Co., Md. 40° F. controlled temperature chamber to the 1st of February; 60° F. controlled temperature chamber to the 20th of March.

    Apical dominance broken. Many sprouts ½ to ¾ inches long. Some shorter.

13. Maryland Eastern Shore late crop. 40° F. controlled storage temperature chamber to the 1st of February; 60° F. controlled storage temperature chamber to the 20th of March.

    Apical sprout ¼ to ½ inches long. Other sprouts very much shorter.

14. Maryland Eastern Shore late crop. Unheated basement until the 1st of February; heated basement to the 18th of March.

    Apical sprout ½ to ¾ inches long. Other sprouts much shorter.

15. Maryland Eastern Shore late crop (3 years). Unheated basement to the 1st of February; heated basement to the 18th of March.

    Apical sprout ¼ to ½ inches long. Other sprouts much shorter.

16. Garrett Co., Md. 40° F. controlled temperature chamber to the 15th of January; 60° F. controlled temperature chamber to the 20th of March.

    Apical dominance broken. Many sprouts 1 to 1½ inches long. Others shorter.

17. Maryland Eastern Shore late crop. 40° F. controlled temperature chamber to the 15th of January; 60° F. controlled temperature chamber to the 20th of March.

    Apical sprout ½ to ¾ inches long. Other sprouts somewhat shorter. Tendency for breaking of apical dominance.

18. Maryland Eastern Shore late crop. Unheated basement to the 15th of January; heated basement to the 18th of March.

    Apical sprout ¾ inch to 1 inch long. Other buds nearly dormant.

19. Maryland Eastern Shore late crop. Unheated basement to the 1st of March; brooder house (approximately 90° F.) to the 18th of March.

Apical sprout ½ to ¾ inches long (more spindly than at lower temperatures). Other sprouts shorter.

Effect of Storage Temperature on Germination, Rank and Maturity

The plots were visited on the 12th of May, and observations were made on the size of the plants. Plants from the Eastern Shore late crop tubers which were kept at 40° F. until the 15th of January, and then at 60° F. until the 20th of April; plants from the Eastern Shore late crop tubers kept in an unheated basement until the 1st of March, and then in a brooder house (90° F.) until the 18th of March; plants from the Maine tubers, and plants from the Garrett County tubers, excepting those kept at 40° F., were approximately three inches high. Plants from Garrett County tubers kept at 40° F. until the 20th of March were slightly smaller than plants from Garrett County tubers kept at 50° F. until the same date. Plants grown from Maryland Eastern Shore late crop tubers kept at 40° F. until the 1st and 15th of February, and then at 60° F. until the 20th of March were somewhat smaller than plants from Maryland Eastern Shore late crop potatoes kept at 40° F. until the 15th of January and then at 60° F. until the 20th of March, but larger than the same seed kept at 40° F. until the 20th of March. Plants from Maryland Eastern Shore late seed raised to 60° F. on the 1st of February were slightly larger than those from the same seed raised to 60° F. on the 15th of February. Plants grown from the tubers kept at controlled temperatures were slightly smaller than those kept at the same approximate temperatures. Practically all of the potato plants matured in the same order as their relative germination.

Effect of Storage Temperature on Yield

The results of three years' study on yield indicate that the effect of the various storage temperatures of Irish Cobbler seed stocks on yield when planted for the early potato crop on the Maryland Eastern Shore is influenced by climatic conditions. If the early part of the season is dry and rains come late, seed which germinates latest and matures latest will usually yield best. If, on the other hand, rains come early and the soil dries out during the latter part of the growing

season, the seed which emerges and matures the earliest will usually give the largest yields. During the same season the effect upon yield of the early and late maturing seed will depend upon the water retaining capacity of the soil. Former studies by the writer and Oswald (6) indicate that on the Eastern Shore of Maryland larger yields can usually be expected from Irish Cobbler seed stocks which germinate and mature the earliest.

In 1934 the months of April and May were cool on the Eastern Shore, and the rainfall was adequate for the potato crop. Hot and dry weather prevailed during the months of June and July. The largest yields were obtained from the Eastern Shore late crop seed which was warmed on the 15th of January until planting time (245 bu. U. S. No. 1 and U. S. No. 2 potatoes to the acre) and the next largest yield (227 bu. U. S. No. 1 and U. S. No. 2 potatoes to each acre) from North Dakota seed. The yield from Eastern Shore late crop seed which was kept in an unheated basement during the entire storage period yielded only 215 bushels of U. S. No. 1 and U. S. No. 2 potatoes. This seed germinated and matured ten days later than the North Dakota seed stock and the home grown Eastern Shore seed which had received the warming-up treatment.

In 1935 April and May were very dry, but sufficient rain fell in June and July to benefit the potato crop. The yield from the Eastern Shore late crop seed which was kept in an unheated basement during the entire storage period gave 301 bushels to each acre of U. S. No. 1 and U. S. No. 2 potatoes. The yield from the same seed warmed up from the 15th of January until planting time was only 237 bushels to the acre of U. S. No. 1 and U. S. No. 2 potatoes. The yield from Maine seed which germinated at the same time as the warmed seed yielded 202 bushels to each acre of U. S. No. 1 and U. S. No. 2 potatoes.

The season in 1936 was very similar to that of 1935. On the same type of land; i. e., land which does not retain moisture, results were very similar in 1935 and 1936. The yield from the Eastern Shore seed kept in an unheated basement during the entire storage period was 281 bushels of U. S. No. 1 and U. S. No. 2 potatoes, and the yield from the same seed stock warmed from the 15th of January until planting time produced only 267 bushels of U. S. No. 1 and U. S. No. 2 potatoes.

During this season an additional test plot was planted in an adjacent field on the farm of W. T. Pilchard at Pocomoke with seed kept at controlled storage temperatures. The soil in this field retained more moisture than the soil in the other test plots. The yield from the Eastern Shore seed kept at a constant temperature of 40° F. from the

14th of November to the 15th of January, and 60° F. from the 15th of January to the 20th of March was 352 bushels of U. S. No. 1 and U. S. No. 2 potatoes. The yield from the same seed kept at a constant temperature of 40° F. from the 14th of November to the 20th of March was 242 bushels per acre of U. S. No. 1 and U. S. No. 2 potatoes.

The yield from the mountain grown Garrett County seed kept at a constant temperature of 50° F. from the 14th of November to the 20th of March was 272 bushels per acre. The yield from the same seed kept at a constant temperature of 40° from the 14th of November to the 20th of March was 263 bushels per acre of U. S. No. 1 and U. S. No. 2 potatoes. The yield, from the same seed kept at 40° F. from the 14th of November to the 1st of February, and at 60° F. from this date until the 20th of March was 236 bushels per acre of U. S. No. 1 and U. S. No. 2 potatoes. For further details see accompanying tables.

TABLE 1.—*Storage temperature studies with Irish Cobbler seed potatoes at Pocomoke, Md. in* 1934.

Seed Source	Storage Condition	Yield in Bushels per Acre		
		U. S. No. 1 & 2	[redacted] Culls	Total
Eastern Shore	*Unheated basement until Jan. 15 **Heated basement until planted	245	38	283
North Dakota	Unheated basement entire time	227	39	266
Eastern Shore	Unheated basement until Feb. 14 Heated basement until planted	219	45	264
Eastern Shore	Unheated basement entire time	215	28	243
Prince Edward Island	Unheated basement entire time	210	44	254
Maine	Unheated basement entire time	175	44	219

*The temperature of the unheated basement was approximately 40° to 45° F.
**The temperature of the heated basement was approximately 60° to 65° F.

TABLE 2.—*Storage temperature studies with Irish Cobbler seed potatoes at Pocomoke, Md. in* 1935.

Seed Source	Storage Condition	Yield in Bushels per Acre			
		U. S. No. 1	U. S. No. 2	Culls	Total
Eastern Shore	*Unheated basement entire time	264	37	10	311
Eastern Shore	Unheated basement until Feb. 15 **Heated basement until planted	234	54	19	307
Eastern Shore	Unheated basement until Jan. 15 Heated basement until planted	182	55	14	251
Garrett Co.,Md.	Unheated basement entire time	176	56	15	247
Maine	Unheated basement entire time	145	62	24	231

*The temperature of the unheated basement was approximately 40° to 45° F.
**The temperature of the heated basement was approximately 60° to 65° F.

Bushnell (2) compared Ohio late grown Irish Cobbler seed potatoes kept at approximately 40° F. during the entire storage period with the same seed kept at approximately 40° F. until the 1st of March and then kept at 68° F. until planted. In 1935 the warmed seed yielded 402.5 bushels of large potatoes to the acre, whereas the same seed kept at ordinary storage during the entire storage period yielded 329.6 bushels. The warmed Ohio late grown potatoes yielded more than the samples of Cobblers obtained from New York and Maine. In 1936 the warmed Ohio late crop Irish Cobbler seed potatoes yielded 102.4 bushels to each acre of large potatoes compared with a yield of 84.5 bushels to the acre of large potatoes from the same seed kept in ordinary storage during the entire storage period. Some of the Maine, New York and Minnesota samples yielded more than the Ohio warmed late crop seed, but the yield from the Ohio warmed late crop seed was greater than the average yield from all Cobblers tested (average yield of all Irish Cobblers tested 83.8 bushels to each acre of large potatoes).

TABLE 3.—*Storage temperature studies with Irish Cobbler seed potatoes at Pocomoke, Md. in 1936.*

Seed Source	Storage Conditions	Yield in Bushels per Acre			
		U. S. No. 1	U. S. No. 2	Culls	Total
Eastern Shore	*Unheated basement entire time	263	18	4	285
Maine	Unheated basement entire time	263	10	3	276
North Dakota	Unheated basement entire time	260	11	4	275
Eastern Shore	†Sweet potato storage house entire time	256	15	3	274
Garrett Co., Md.	Unheated basement entire time	254	16	4	274
Eastern Shore	Unheated basement until Feb. 1 **Heated basement until March 18	253	18	5	276
Eastern Shore	Unheated basement until Feb. 15 Heated basement until March 18	252	16	5	273
Eastern Shore two years from Maine seed	Unheated basement until Feb. 1 Heated basement until March 18	252	15	4	271
Eastern Shore	Unheated basement until March 1 ††Brooder house until March 18	251	11	3	265
Eastern Shore	Unheated basement until Jan. 15 Heated basement until March 18	245	22	5	272

*The temperature of the unheated basement was approximately 40° to 45° F.
**The temperature of the heated basement was approximately 60° to 65° F.
†The temperature of the sweet potato storage house was approximately 55° F.
††The temperature of the brooder house was approximately 90° F.

TABLE 4.—**Storage temperature studies with Irish Cobbler seed potatoes at Pocomoke, Md. in 1936 with controlled temperatures.*

Seed Source	*Storage Temperatures	Yield in Bushels per Acre			
		U. S. No. 1	U. S. No. 2	Culls	Total
Eastern Shore	40° F. until Jan. 15; then 60° F. to March 20	334	18	10	362
Eastern Shore	40° F. until Feb. 15; then 60° F. to March 20	312	24	12	348
Eastern Shore	50° F. until March 20	293	27	15	335
Eastern Shore	40° F. until Feb. 1; then 60° F. to March 20	275	24	16	315
Eastern Shore	40° F. until March 1; then 90° F. to March 18	273	17	5	295
Garrett Co., Md.	50° F. until March 20	248	24	12	284
Garrett Co., Md.	40° F. until March 20	236	27	17	281
Eastern Shore	40° F. until March 20	224	18	12	254
Garrett Co., Md.	40° F. until Feb. 15; then 60° F. to March 20	218	54	36	308
Garrett Co., Md.	40° F. until Feb. 1; then 60° F. to March 20	194	42	24	260
Garrett Co., Md.	40° F. until Jan. 15; then 60° F. to March 20	194	36	18	248

Rest period broken in Garrett County seed December 5-9.
Rest period broken in Eastern Shore seed January 22-27.
*Potatoes stored on November 14, 1935.

EFFECT OF STORAGE TEMPERATURE TREATMENTS ON THE PHYSICAL-CHEMICAL PROPERTIES OF THE EXPRESSED POTATO SAP.

Some physical-chemical properties were determined on the sap from samples of tubers comparing the Eastern Shore with mountain-grown Irish Cobbler potatoes subjected to the same storage treatment conditions as previously listed in this paper. Samples were taken and analyzed at the beginning, and at the end of the storage period, as well as at intervals during storage. Six tubers taken for each sample,

TABLE 5.—*Physical analysis of Irish Cobbler potatoes held in storage at 40 F. controlled temperature.*†

Date of Analysis	Source	Per Cent Dry Matter	Per Cent Moisture	pH	Osmotic Pressure	Sp. Conductance × 10^{-6}
Nov 18	*Garrett Co.	4.03	78.92	5.55	5.6093	9164
	**Eastern Shore	4.83	80.43	5.77	6.5388	11018
Jan. 20	Garrett Co.	5.22	77.65	5.92	6.9180	11001
	Eastern Shore	5.80	80.74	5.90	8.1694	9443
Feb. 15	Garrett Co.	4.77	77.73	6.13	7.2477	9176
	Eastern Shore	6.60	80.96	5.93	7.7904	10615
Mar. 12	Garrett Co.	4.88	81.43	6.06	7.1755	9707
	Eastern Shore	5.22	80.48	6.08	7.6111	10896
Mar. 15	Garrett Co.	4.37	79.32	6.04	5.3591	9994
	Eastern Shore	4.15	81.37	6.11	5.5799	10421
Average	Garrett Co.	4.65	79.01	5.94	6.4619	9808
	Eastern Shore	5.32	80.80	5.96	7.1379	10479

†Stored November 14, 1935, to March 15, 1936.
*Potatoes dug August 28, 1935; rest period broken 100 days.
**Potatoes dug November 4, 1935; rest period broken 80 days.

TABLE 6.—*Physical analysis of Irish Cobbler potatoes kept under various storage temperature conditions.*†

Date of Analysis	Source	*Temp. Treatment	Per Cent. Dry Matter	Per cent. Moisture	pH	Osmotic Pressure	Sp. Conductance · × 10^{-6}
Nov. 18	Garrett Co.	40—Nov. 14	4.03	78.92	5.55	5.6093	9164
	Eastern Shore	Same	4.83	80.43	5.77	6.5388	11018
Mar. 15	Garrett Co.	40—Feb. 15					
		60—Mar. 15	4.57	78.24	5.98	6.3919	10006
	Eastern Shore	Same	4.59	80.60	6.23	6.8662	8815
Mar. 15	Garrett Co.	40—Feb. 1					
		60—Mar. 15	4.33	77.01	5.90	6.5189	10072
	Eastern Shore	Same	4.49	80.40	6.25	6.2342	10974
Mar. 15	Garrett Co.	40—Jan. 15					
		60—Mar. 15	4.50	78.23	6.06	6.1391	10430
	Eastern Shore	Same	4.54	80.33	6.38	6.6038	9940
Mar. 15	Garrett Co.	40 Con.	4.37	79.32	6.04	5.3591	9994
	Eastern Shore	Same	4.15	81.37	6.11	5.5799	10421
Mar. 15	Garrett Co.	50 Con.	4.70	76.07	6.17	6.2615	10668
	Eastern Shore	Same	5.00	79.91	6.15	5.7257	11104
Average	Garrett Co.		4.42	77.97	5.95	6.0466	10056
	Eastern Shore		4.60	80.51	6.15	6.2581	10379

*Temperature read in Fahrenheit degrees.

were washed and dried, and cut in half. Only one-half of each tuber was used for the analysis. The halved tubers were quartered and run through the Nixtamal Mill. The freshly ground tissue was stirred well and duplicate small portions were placed in tarred moisture dishes for total moisture determinations. They were weighed, and dried to constant weight at 80° C. in a vacuum oven.

The cell sap was extracted from the macerated potato tissue by means of the standard hydraulic press, having a test cylinder 1.12 inches in diameter, and equipped with necessary filter pads and pan. A uniform pressure of 5,000 pounds to the square inch was used on each sample of tissue, and allowed to drain four minutes after the maximum pressure was reached. The extracted sap was placed in a chilled test-tube and kept in ice water.

Hydrogen ion concentration measurements were made immediately on the sap by using the Youden apparatus with the quinhydrone cell. Another sample of sap was immediately placed in a conductivity cell and kept at a constant temperature of 25° C. in a water bath. Specific conductivity measurements were made with a Wheatstone Bridge, headphone apparatus. Four positions on the bridge were selected throughout the series of all samples and duplicate readings were made at each setting.

Dry matter determinations were made on the expressed sap, in duplicate, by the use of both the Abbé Refractometer, with Geerlig's conversion tables, and the oven drying method, with a temperature of 65-70° C. The Refractometer readings averaged 14 per cent higher dry matter in the cell sap than did those determined by the oven dry method.

The osmotic pressure of the expressed sap was determined by the freezing point method. These determinations were made, in duplicate samples, with the usual freezing point apparatus, fitted with a Beckman thermometer. The observed readings were corrected for undercooling, and the osmotic pressure values were calculated.

Some of the outstanding results obtained are presented for comparison of the Eastern Shore with the mountain-grown Irish Cobblers under the same storage conditions.

The dry matter content of the Eastern Shore tubers was high when first placed in storage, at 40° F. temperature, and increased greatly after three months' storage, after which there was a rapid decrease until a minimum was reached at the end of the four months' storage period. Tubers removed from 40° F. storage temperature and placed at 60° F. on various dates tended to show

a greater amount of dry matter at the end of the storage period than those stored at 40° F., constant temperature. Those held at 50° F. were likewise higher than those at 40° F. The mountain grown Cobblers had minimum dry matter at the beginning of storage, and showed an increase during the first two months and a tendency for a gradual decrease to the end of the storage period when kept at 40° F. The dry matter was higher at 50° F. than at 40° F. The Eastern Shore seed consistently showed more dry matter than the mountain grown tubers regardless of the storage treatment, until the end of the storage period when it suddenly became less.

The total moisture did not vary appreciably in either the Eastern Shore or the mountain grown potatoes regardless of the treatment, although they tended to gain some moisture at 40° F. constant temperature, and lose at 50° F. temperature. The Eastern Shore tubers showed an average of 2.68 per cent more moisture than the mountain-grown seed under the same storage treatment.

The hydrogen ion concentration of the Eastern Shore potatoes held at 40° F. temperature increased from pH 5.77 to 6.11 during the four months' storage period; whereas, the mountain-grown cobblers increased pH during the first two months and decreased somewhat during the remaining period of storage. By March 15, the Eastern Shore tubers showed a higher pH value when the tubers were removed from the 40° F. temperature and placed at 60° F. temperature on the 15th of January, than when placed at the higher temperature on the 1st or 15th of February. The pH reading of the mountain grown seed varied. The pH of both was greater at 50° F. than at 40° F. constant temperature storage, at the end of the storage period.

The osmotic pressure of the cell sap of the Eastern Shore tubers increased to a maximum during the first two months of storage, whereas the mountain grown tubers reached a maximum in three months' storage at 40° F. Both decreased in like proportion at the end of the storage period following the maximum increase. At 40° F. the Eastern Shore seed constantly had the higher osmotic pressure values, although both showed a higher value at 50° F, than at 40° F. constant temperature storage.

The specific conductance of the Eastern Shore potatoes was higher than the mountain grown seed kept at the same temperature although both seed sources yielded a higher value at the higher storage temperature.

Summary and Conclusions

1. When kept at ordinary storage temperatures (approximately 40° F. during the entire storage period) northern and mountain grown Irish Cobbler seed potatoes germinate and mature about ten days earlier than late grown Eastern Shore Irish Cobbler seed potatoes.

2. Increasing the storage temperature of late grown Eastern Shore Irish Cobbler seed potatoes stimulates sprout growth, the amount of stimulation depending upon increase in temperature and the time of exposure to the increased temperature.

3. Late grown Eastern Shore Irish Cobbler seed potatoes may be made to germinate and mature as early as northern and mountain grown Irish Cobbler seed potatoes. By varying the storage temperatures and the time of exposure to different temperatures, the time of emergence may be controlled within a period of ten days.

4. The effect of the various storage temperatures of Irish Cobbler seed stocks on yields when planted for the early potato crop on the Eastern Shore of Maryland is greatly influenced by climatic conditions. If the early part of the season is dry and rains come late, seed which germinates latest and matures latest will usually yield best. If, on the other hand, rains come early and the soil dries out during the latter part of the growing season, the seed which germinates and matures the earliest will usually give the largest yield. The latter condition is most prevalent on the Maryland Eastern Shore.

5. The results of one year's tests indicate that mountain grown Irish Cobbler seed potatoes kept at 50° F. yield better than the same seed kept at 40° F. when planted for the Maryland Eastern Shore early crop. They also indicate that any further increase in the storage temperature of mountain grown seed decreases the yield when planted for the early Eastern Shore crop.

6. The results from the physical-chemical analysis of the expressed sap have indicated a greater percentage of dry matter for both the Eastern Shore and the mountain-grown cobblers at 50° F. storage temperature, whereas total moisture was greater at 40° F. constant temperature. The total moisture of the Eastern Shore tubers decreased with the increased length of storage at the higher (60° F.) temperature. There was consistently more total moisture in the Eastern Shore, than in the mountain-grown cobblers at all storage temperatures.

7. The sap from both the Eastern Shore and mountain-grown cobblers showed a higher pH value at 50° F. than at 40° F. constant storage temperature. The osmotic pressure and the specific conductance values were higher at 40° F. storage temperature for the Eastern Shore than for the mountain-grown cobblers.

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NOTES AND BRIEF ARTICLES

THE CHICAGO CONFERENCE ON SEED POTATO CERTIFICATION

K. W. LAUER
Department of Agriculture, Harrisburg, Pa.

The conference called by Joe C. Scott, President of the Oklahoma State Board of Agriculture for the purpose of drawing a standard seed potato quarantine for all of the southern, or seed potato consuming states which will meet the approval of the northern, or seed potato producing states, was held in Chicago on the 26th and 27th of October. Twenty-two men, representing the following states, attended the meeting: Alabama, Arkansas, Illinois, Indiana, Kansas, Michigan, Missouri, Nebraska, New York, North Dakota, Oklahoma, Pennsylvania, Tennessee, Wisconsin and Wyoming. Eight of these states represented seed producing states and seven seed consuming states, including Tennessee which was represented by the L. O. N. Railroad.

When the call for the conference was received, a number of the men in the certified seed producing states felt that possibly the certified seed potatoes shipped into the south were not giving the

results desired by the southern planters. This was apparently far from the facts, as was brought out during the discussion at the conference when the southern states' representatives placed their problem before the group. The men from the seed consuming states, without exception, stated that certified seed had proven entirely satisfactory and that it was giving results that were "very, very nice."

Representatives from the seed consuming areas stated that most of the seed they used was non-certified and practically all of it was bought under the term "selected," "inspected," "one-year removed from certified" or some other similar attractive term that proved deceptive to the uninformed buyer and that a large amount of this seed was proving to be nothing more than junk.

In the state of Oklahoma alone they require annually approximately one thousand cars of seed potatoes, four hundred and fifty of which go to the commercial planter and only one car in fifty consists of certified seed. Last year, from fifty cars inspected in this state, twenty-two straight cars were rejected as being entirely unfit for seed purposes. This rejected stock was re-shipped into other neighboring states which had no restrictions on the importation of seed potatoes. It was this situation which led indirectly to the desirability of having uniform restrictions concerning what should constitute seed potatoes in the southern consuming states.

In nearly all the southern states apparently fifty per cent or more of the seed used is sold to the small grower, whose annual seed requirements are ten sacks or less. Most of this seed is brought in by brokers and seed dealers, and is sold through grocery, hardware or other similar small business establishments.

Not being able to carry over any seed from year to year, they must depend on the northern states for their seed supply. The problem facing the southern seed consuming states, as the southern representatives expressed it, was to secure for their growers a better quality of seed. Although they agreed that a considerable volume of the non-certified seed they were receiving was giving good results, a large volume was entirely unsatisfactory. They felt that, even though they were to place quarantine restrictions against non-certified seed, they would be penalizing their own growers because the certified seed producing states could not furnish a sufficient volume of seed to supply the needs of these consuming states. The representatives of the several southern states that now have restrictions and require that all non-certified seed be in-

spected at the receiving point feel that, without the cooperation of the shipping states, their regulations are frequently entirely ineffective, especially when virus diseases are involved. They feel that their Federal-State shipping point inspection service can take care of any visible defects or blemishes which might render the tubers unfit for seed purposes, but such diseases as spindle tuber, mosaic, leafroll, etc., must be detected during the growing season in the state in which the seed was grown. To solve this problem, the men from the seed consuming states requested the representatives from the seed producing areas to establish a field inspection of seed potatoes other than certified seed. The certified seed producing states were to continue producing certified seed and, if possible, increase the production of certified seed but, in addition, were to supply to the seed consuming states a "B" grade of inspected seed stock which would carry the stamp of approval of the regular certification agency. It was the expressed feeling of the seed consuming states' representatives that this conference was to work out standards and establish definite disease tolerances for a "B" grade of seed, which would be more liberal than is required for certified seed but which would be satisfactory to both the northern and the southern states representatives.

During the discussion that followed during committee meetings and during the conference, representatives of the seed producing states pointed out that to establish a "B" grade of seed would: (1) Require a reorganization of the certification inspection work in the various states; (2) raise the cost of such seed to or near the same level as certified seed; (3) weaken the certification set-up by putting official approval on an inferior quality of seed; and (4) result in disappointment to the southern seed consuming states because the inspections would prove to be inadequate and superficial.

The seed producing states' representatives also suggested that the southern seed consuming states enact regulations or, if necessary, legislation defining the term "seed potatoes," making it unlawful to sell or offer for sale any seed potatoes unless they were properly certified. It was felt that such legislation would eliminate most of the commercial deception that was being practiced in connection with the sale of "near certified" seed that was being sold throughout the seed consuming states.

Although several of these states now have such regulations or legislation in effect, the seed consuming states' representatives felt

that this procedure would not produce any immediate solution of their problem. They agreed, however, that their ultimate aim was to permit the sale of only certified seed in the various seed consuming states represented but, until a sufficient volume of certified seed was available to supply their needs, any regulatory action to eliminate all non-certified seed would be inadvisable. The problem of working out a satisfactory solution was finally placed in the hands of a committee, composed of three representatives from the seed consuming, and three from the seed producing states. This committee was unable to arrive at a mutual agreement that would be acceptable to both groups. The conference did, however, adopt a resolution presented by the committee to have each state take such action as is necessary to eliminate and prevent the abuse of such terms as "near certified," "selected," etc., when applied to seed potatoes. The conference also agreed that this committee of six should continue to function during the year and that they were to draw up plans for a permanent organization of representatives of seed consuming and seed producing states. Membership in this permanent organization is to be confined to officials in charge of the seed potato certification work, quarantine officers, or such other officers who might be actively interested in the production or consumption of seed potatoes.

Although the conference failed to arrive at a satisfactory solution regarding the seed consuming states' problem, the representatives from both the northern and the southern states agreed that the meeting was well worth while and that it did provide an opportunity for the two groups to place before each other questions of vital importance to both sections. For this reason alone, the conference served its purpose well.

If, as a result of this meeting, a permanent organization should be developed, it would provide a means of assembling interested groups and give an opportunity for officials of these areas to discuss just such problems as were presented at this conference. There is no doubt that some way will be found to provide better seed potatoes for the southern states, even though they face the immediate future with no prospects of being provided with better seed. The mere fact that this conference focused the attention of the two groups on this problem will certainly have some effect on improving the quality of seed shipped to them from the seed producing states.

There was no doubt in the minds of any of the representatives

at the conference that the southern seed potato consuming states have a big problem. We from the northern seed producing states cannot overlook this and we should co-operate to the fullest extent in finding the answer.

PROGRAM OF THE TWENTY-FOURTH ANNUAL MEETING OF THE POTATO ASSOCIATION OF AMERICA

December 28 to 30, 1937

President, FRED H. BATEMAN, *York, Pennsylvania*
Secretary, WILLIAM H. MARTIN, *Rutgers University, New Brunswick, N. J.*

Tuesday Afternoon, Joint Session with Vegetable Crops Section of American Society for Horticultural Science, and American Society of Agronomy. December 28, 2:00 p. m., Riley Room, Claypool Hotel.

The Life and Work of Percy E. Brown (deceased Retiring Vice-President for Section on Agriculture), Jacob G. Lipman, New Jersey Agricultural Experiment Station, New Brunswick, N. J.

Symposium: The Rôle of Minor Element Fertilization in Economic Plant Production.

E. C. AUCHTER, *Chairman*

1. *Minor Elements in Relation to Major Soil Problems.* (20 min.) L. G. WILLIS and J. R. PILAND, North Carolina Agricultural Experiment Station.

2. *Minor Elements in Greenhouse Vegetable Production.* (15 min.) I. C. HOFFMAN, Ohio Agricultural Experiment Station.

3. *Boron Deficiency in Cauliflower and Spinach on Long Island.* (15 min.) JOHN D. HARTMAN, Purdue University.

4. *A Preliminary Note on the Control of Internal Breakdown in Beets by the Use of Boron.* (10 min.) G. J. RALEIGH and C. B. RAYMOND, Cornell University.

5. *The Importance of Zinc in Pecan Production.* (20 min.) H. L. CRANE, Bureau of Plant Industry, U. S. Department of Agriculture.

6. *Potato Quality as Influenced by Growth Conditions.* (10 min.) ORA SMITH and L. B. NASH, Cornell University.

7. *Magnesium as an Essential Element in Potato Production.* (15 min.) Jos. A. CHUCKA, University of Maine, and B. E. BROWN, U. S. Department of Agriculture.

8. *Minor Element Considerations in Hydroponic Plant Culture.* (15 min.) W. F. GERICKE, University of California.

Wednesday Morning Session, December 29, 9:30 a. m.; Room 1625-26, Washington Hotel.

1. Appointment of Committees.
2. Report of the Secretary-Treasurer, Editor.
3. Presidential Address. FRED H. BATEMAN, York, Pennsylvania.
4. Report of the Potato Improvement Committee. JULIAN C. MILLER, Chairman, Louisiana State University.
5. Report of the Committee on Nomenclature. CHAS. F. CLARK, Chairman, U. S. Department of Agriculture.
6. Report of the Committee on Standardization of Field Plot Technique. J. R. LIVERMORE, Cornell University and H. O. WERNER, University of Nebraska.
7. *Potato Tuber Bruising in the Cleveland and Rochester Markets.* (15 min.) E. V. HARDENBURG, Cornell University.
8. Report of the Committee on Potato Consumption and Dietetic Value. E. V. HARDENBURG, Chairman, Cornell University.
9. *Immediate Germination of Certain Selfed and Hybrid Potato Seed.* (15 min.) M. L. ODLAND, University of Minnesota.
10. *Selection for Flowering, Fruiting and Seed Production in the Potato.* (15 min.) F. A. KRANTZ and Z. M. FINEMAN, University of Minnesota.
11. *Relative Maturity of Potato Seedlings under Greenhouse and Field Conditions.* (15 min.) F. A. KRANTZ, University of Minnesota.
12. *Potato Insect Investigations in* 1937. G. F. MACLEOD, Cornell University.
13. *The Measurement of Scab Resistance and a Study of the Character in Selfed and Hybrid Progenies of Potatoes.* (10 min.) J. G. LEACH, F. A. KRANTZ, PHARES DECKER and HAROLD MATTSON, University of Minnesota.

Wednesday Afternoon Session, December 29, 2:00 p. m.; Room 1625-26, Washington Hotel.

1. Report of Committees.
2. *The Value of Summer Legumes for Potatoes in South Alabama.* (10 min.) L. M. WARE, Alabama Polytechnic Institute.
3. *Green Manure Crops for Potatoes.* (15 min.) ORA SMITH, Cornell University.
4. *The Effect of Preceding Crops on Yields of Green Mountain Potatoes.* (15 min.) G. F. LEA and T. E. ODLAND, Rhode Island State College.
5. *Commercial Fertilizers in Colorado in* 1937. (15 min.) C. H. METZGER, Colorado State College.
6. *The Effect of Soil upon the Cooking Quality of Varieties of Potatoes Raised in Minnesota.* (10 min.) ALICE M. CHILD, University of Minnesota.
7. *The Cobbler Seed Supply of the United States.* (15 min.) C. L. FITCH, Iowa State College.

8. *Potato Programs Now in Operation and Possible Approaches to Future Potato Programs.* (20 min.) A. E. MERCKER, U. S. D. A.

9. *Some New Potato Dust Combinations.* (10 min.) W. A. RAWLINS, Cornell University.

10. Report of the Committee on the Standardization of Cooking Tests. E. J. WHEELER, Chairman, Michigan State College.

11. Report of the Seed Potato Certification Committee. KARL FERNOW, Chairman, Cornell University.

12. *Progress in Virus Disease Investigations in* 1937. T. P. DYKSTRA, U. S. Department of Agriculture.

13. *Potato Culture and Storage Investigations in* 1937. E. V. HARDENBURG, Cornell University.

14. *Potato Breeding Investigations in* 1937. C. F. CLARK, U. S. Department of Agriculture.

Thursday Morning Joint Session with American Phytopathological Society, December 30, 9:00 a. m.; Rainbow Room, Hotel Severin.

C. R. ORTON, *Chairman*

1. *The Resistance of Katahdin Potato Seedlings to Infection by the Veinbanding Virus and the Tobacco Mosaic Virus.* (10 min.) LEON K. JONES and EARL F. BURK, Washington State College.

2. *Soil Temperature in Relation to Potato Yellow Dwarf.* (15 min.) (Lantern) J. C. WALKER and R. H. LARSON, University of Wisconsin.

3. *Microchemical Studies of Potato Tubers Affected with "Blue Stem."* (10 min.) (Lantern) L. M. HILL and C. R. ORTON, West Virginia University.

4. *Further Observations on "Blue Stem."* (15 min.) C. R. ORTON and L. M. HILL, West Virginia University.

5. *Building up Virulence in Phytophthora infestans.* (10 min.) Donald Reddick, Cornell University.

6. *Fusarium avenaceum (Fr.) Sacc., A Vascular Parasite of Potato.* (15 min.) (Lantern) JOHN G. MCLEAN, University of Wisconsin.

7. *A New Potato Disease in Colorado.* (15 min.) C. H. METZGER, Colorado State College.

8. *A Potato Wilt Caused by the Tarnished Plant Bug, Lygus pratensis L.* (10 min.) (Lantern) J. G. LEACH and PHARES DECKER, University of Minnesota.

9. *Potato Spraying Experiments in Louisiana During* 1936-1937. MILTON A. PETTY, JR., University of Minnesota.

10. *Potato Spraying in Eastern Virginia in* 1937. (5 min.) (Lantern) LAUREN D. ANDERSON and HARRY G. WALLER, Virginia Truck Experiment Station.

11. *Bacterial Wilt and Soft Rot of the Potato a Serious Disease.* (10 min.) (Lantern) REINER BONDE, Maine Agricultural Experiment Station.

12. *Bacterial Wilt and Rot of Potatoes.* (15 min.) (Lantern) H. N. RACICOT and C. B. O. SEVILE, Central Experimental Farm, Ottawa.